Gas Journal

VOL. 298 | 111th YEAR | LONDON, APRIL 1, 1959 | No 4994 | PRICE 1/6

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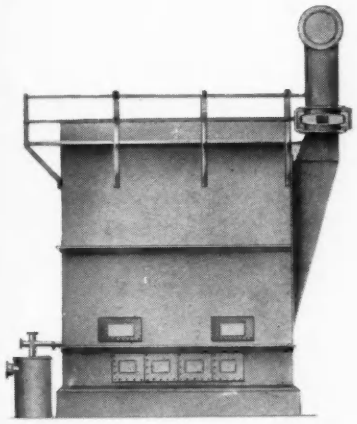
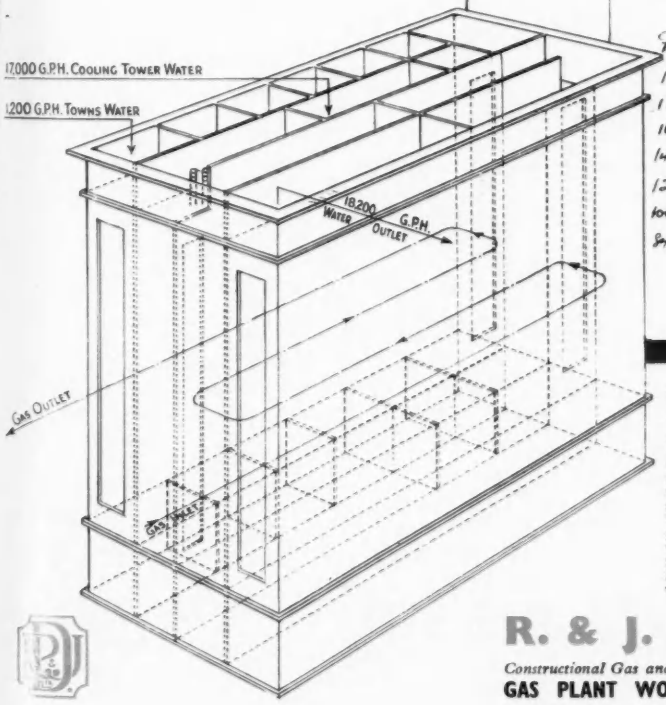
CROSS TUBE FLOW CONDENSER

for

GAS COOLING





Research & Development Dept.

Continuation Sheet No. 6

HORIZONTAL FLOW GAS CONDENSER cont.

Gas flow = 166,000 cu ft hr (STP)

Minimum STP velocity = 5.16 f.p.s.
Maximum STP velocity = 6.74 f.p.s.
Average STP velocity = 5.95 say 6.0 f.p.s.

All water passes arranged thus:

7 rows tubes (7) } 13 rows/pass
6 rows tubes (6) }
or 44 × 36 = 85 tubes/pass
or 13 × 12 = 156 rows/condenser

Cooler = 19,150 gphr. Cooler vel. = $\frac{19,150 \times 144}{3600 \times 6.94 \times 2 \times 85}$ = 0.6 f.p.s.

The gas pressure drop may be calculated from,

$$\Delta p = \frac{4f N l \rho V^2_{max}}{2g}$$

using consistent units.

when $f = 0.75 \left(\frac{De\, V_{max}\, \rho}{\mu}\right)^{-0.2}$

and for $\frac{De\, V_{max}\, \rho}{\mu} > 40$.

% of area for temperature ranges adopted.

Range.	% Area	Number of Tube Rows
180° – 180°	6.4	10
180° – 160°	19.4	30
160° – 140°	12.7	20
140° – 120°	11.0	17
120° – 100°	14.6	23
100° – 84°	16.6	26
Sat. 75°	19.3	30
	100.0	156

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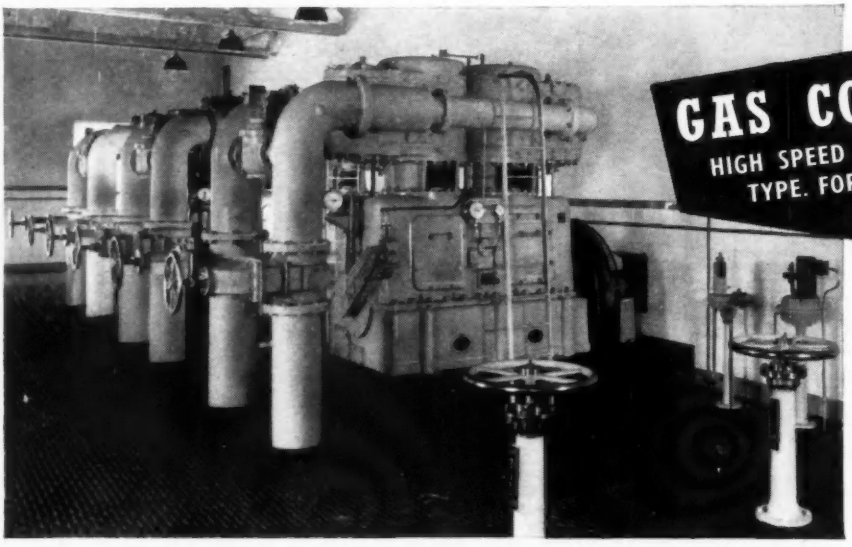

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Gas Journal

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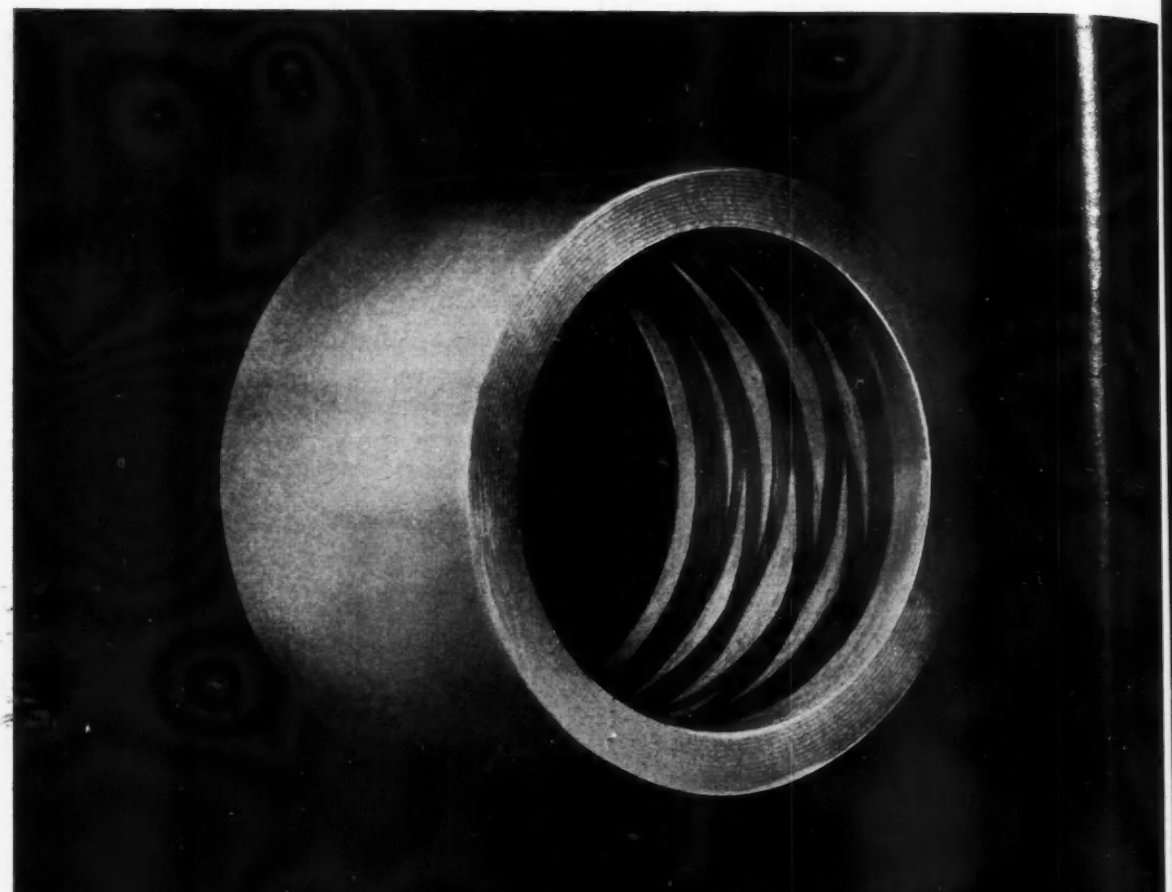

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Gas Journal

VOLUME 298. No. 4994 APRIL 1, 1959. 111th YEAR

A Sensible, if Negative, Report

ADVOCATES of closer co-operation between the gas and electricity industries will have been disappointed by the report of Sir Cecil Weir's committee published last week. Asked to consider whether joint meter reading and billing, shared showrooms and reduced advertising would benefit the consumer, the committee decided that the answer was very much in the negative. Indeed, we can recall few reports making a stronger recommendation for *status quo*. Not that this should be interpreted as denoting any lack of initiative or inventiveness on the part of the committee. On the contrary, this report is a model of its kind—concise, lucid, and painstakingly fair. It has been received with quiet satisfaction by *The Times*, with little interest by most other newspapers, but with irritation by the *Manchester Guardian;* the latter maintained that it was a mistake to man the committee almost entirely from people who sit as whole-time or part-time members of electricity and gas boards. The criticism was ill-founded since it is the members' intimate knowledge of their respective industries which has enabled them to deal objectively with the quite complicated factors involved.

By far the most involved of the various aspects of co-operation considered was meter reading and billing. This is an operation understood very imperfectly by the layman who clearly regards it as constituting one of the strongest cases for joint operation. In fact there is a host of drawbacks, ranging from the consumer's dislike of having to meet a double bill, to the serious complications resulting from trying to merge two accounting offices. In addition, there would be difficulties resulting from Trade Union and Staff Association disapproval of such a scheme, the fact that gas and electricity board areas do not coincide, and loss of pride and enthusiasm on the part of the meter readers and collectors themselves.

In rejecting such a proposal the committee is in good company and follows a clearly blazed trail. It is an interesting fact that only two of the 130 local authorities in Great Britain which owned both gas and electricity undertakings considered it advantageous to have meters read and slot meters emptied on the same visit by the same man acting for the Treasurer in respect of both supplies. Pilot schemes run during the war with the object of releasing men for other work were not found to be practicable, while the independent report from a firm of industrial consultants, commissioned by both industries five years ago, concluded that there was no case for joint meter reading and billing.

On this subject the committee makes two important points. The first is that consultative councils should be given demonstrations of meter reading and slot meter collecting, and be taken to central billing offices in order to see the complexity of the work carried out. 'If this were to become more general practice, with wider knowledge some of the criticism would be dispelled.' Secondly, it points out that for the whole country in the past six years the cost per consumer of this part of the boards' work has increased by only 14½%, despite increases varying between 33% and 50% in the wage rates of employees engaged in this work. 'This improved efficiency seems to us most commendable,' comments the report, 'and, from what we have seen, we expect further improvements in the coming years.'

We note with some satisfaction that both the proposed amalgamation of gas and electricity showrooms and the criticism of advertising by the boards are polished off in relatively few words. Critics of the boards' activities in these spheres have always seemed to us to be so patently short-sighted that we have not taken their accusations very seriously. However, the committee has obviously considered the matter with a very proper gravity and has effectively produced all the right (albeit obvious) answers. In essence they accept that it is Government policy to leave freedom of choice of fuel to the consumer. The staff of a combined showroom, they believe, would find great difficulty in answering the obvious question of a consumer as to which fuel and which appliance was recommended. Moreover, they can see difficulties in the management of separate staffs from the two industries in the same showroom, and they accept that in most cases adequate joint showrooms cannot be established in existing premises, but would require the purchase or building of new ones—at considerable capital cost or increases in rental charges. However, they concede that it is possible that there may be some scope for sharing premises in outlying places

where there is not sufficient business to justify two separate establishments, although even here a better service may be provided by means of the increased use of mobile showrooms.

We do not propose to go into the committee's defence of area board advertising, but in passing we must express our pleasure at the committee's stressing of the fact that the advertising expenditure of the boards is modest in comparison with that of certain other industries, 'even taking into account the special position which each industry occupies by statute in its own field, and the fact that makers of both gas and electrical appliances themselves expend considerable sums in advertising which are additional to those spent by the boards.' This, together with the fact that gas and electricity boards are not only in competition with each other but with other industries, is all too often overlooked. Two points of interest in this section are the defence of the W.G.F. and the E.A.W. (subsidies notwithstanding), and the suggestion that excessive competition in advertising could be avoided by discussion between the chairmen and senior officers of the two industries.

In addition to these basic matters the committee also deals briefly with several other less pertinent (and sometimes downright stupid) suggestions and criticisms. Some of these are dismissed on the ground that they are outside the terms of reference—very properly, since they belong to the sphere of the consultative councils. One quite legitimate point concerns the 'apparently unco-ordinated excavations in the same length of street.' The committee testifies to the good relations existing between the various bodies concerned with digging up streets but points out that it is not always possible to avoid multiple disturbances of streets within a short time. Which is true enough, but from personal observation we would have thought that there was still a good deal of room for improvement. Perhaps the committee's suggestion that the highways authorities should take the lead in convening meetings of interested parties when street works are involved will prove helpful.

The committee is to be congratulated on a workmanlike and helpful report even though, as *The Times* remarked, 'the result of the investigation is almost wholly negative.' Perhaps this will help to quieten some of those angry spirits who continue to regard the nationalised fuel industries as wasteful and inefficient. At all events it bears out the views expressed some months ago by Lord Mills who made it abundantly clear that in his view the interests of the consumer were best served by fostering virile competition between the fuels.

Anyone for Industrial Gas?

SCOPE for industrial gas engineers is expanding; scope for gas production engineers is narrowing. Is the former profession likely to appeal to those who have started their careers in the latter? The question arises as a result of some remarks made by Mr. R. F. Saggers, Ipswich Divisional Industrial Gas Engineer, Eastern Gas Board, in a paper presented to the Eastern Juniors recently. We shall be publishing this paper in our 'Gas in Industry' supplement, but we have lifted from the paper this one brief section because it would appear to have particular interest.

Mr. Saggers, with a hint of persecution complex, pointed out that industrial gas engineers were often regarded with suspicion by district people, with anxiety by accountants who made scathing remarks about selling under costs, and with some misgiving by works and distributing engineers who spoke with feeling of intermittent peak loads. But, he went on, now that industrial gas was becoming such a vital part of gas business, it should be pointed out that there were far too few industrial engineers, some 200 men dealing with annual sales of 786 mill. therms. If industrial gas sales were to be properly developed, which required more time on the factory floor, it was obvious that more men were required. There had been some difficulty experienced in this respect because an area board had only been able to increase its coverage at the expense of other boards, creating a merry-go-round of transfers. Some boards had been able to recruit young men from other departments and provide adequate training, but this was not always possible. One of the chief hindrances appeared to be a reluctance to regard the work as definite career. Mr. Saggers claimed that industrial gas offered more scope, interest, personal satisfaction, and future prospects for a young man just finishing his examinations, than any other part of the industry. Such a man, he maintained, should be technically minded, unworried by noise, smells or odd working hours, have some flair for experimenting and possess a working knowledge of other fuels.

And then came Mr. Saggers' suggestion: 'There must be many young men on the manufacturing side of the gas industry who might be worried about their personal careers because of the growing tendency towards large gasworks. I suggest that they fulfil many of these qualifications and that they could well take a second look into their futures, and think seriously of going for the next industrial vacancy that crops up.'

Junkers

IN February *Das Gas und Wasserfach* commemorated the centenary of Hugo Junkers, born on February 3, 1859, a man of most remarkable versatility whose life story is written by Johannes Körting of Karlsruhe. Any one of Junkers' main inventions would be enough to make him famous. His calorimeter, his instantaneous water heater —the 'geyser'—are well known to the gas industry, while his internal combustion engines and his (the first) all-metal aeroplane are known the world over.

In the early years of this century he realised the danger to the gas industry of competition from electricity and set himself to find a substitute for the diminishing lighting load. He saw that the way to safety lay in the development of gas as a heating agent. The geyser, the now familiar run-through water heater, was originated by him. He conceived the high combustion chamber, which dispensed with the necessity for the Bunsen burner, and made the first oven with radiant heating, with 'neat' gas (as we say now). The resultant convection heat-exchanger was constructed by him in flat-pressed, soldered copper pipes laid close together, to which he afterwards added the fins on the gas side to increase heat transfer. Junkers studied very closely the removal of combustion products from gas appliances and was the first to recognise the differences in the problems of uptake flues from solid and gaseous fuels. Success with his gas-heated ovens led him and his colleague, Paul Spalick, to a thorough investigation of the optimum economy conditions for a system of gas-fired space heating.

Personal notes

MR. ROBERT CAMPBELL, district supervisor for Dunkeld, Pitlochry and Aberfeldy, has been appointed Service and Sales Superintendent of the combined areas of Cowdenbeath, Lochgelly, Kelty, Cardenden and Kinross. MR. JAMES D. BEATTIE, distribution foreman at Cowdenbeath, has been appointed District Inspector in the new set-up in Cowdenbeath area. MR. THOMAS THOMSON, distribution foreman at Kelty, is joining the distribution staff and will be responsible for that function in the Cowdenbeath area. All the work in the Cowdenbeath area will be supervised by group functional officers stationed at group headquarters in Dunfermline.

MR. WILLIAM T. GILCHRIST, formerly district gas manager for Cowdenbeath, Kelty and Lochgelly for 11 years, has been appointed Assistant Group Service and Sales Manager at Dundee. Mr. Gilchrist, who has been operating in a managerial capacity in the gas industry for over 20 years, joined the Cowdenbeath Gas Company in 1948 as engineer and manager, and became district manager on nationalisation a year later. In 1956 his duties were extended to incorporate the managership of the adjacent undertakings at Kelty and Lochgelly. Before going to Cowdenbeath, Mr. Gilchrist held managerial positions with Prestonpans and Tranent Gas Companies, Inverurie Gas Company, and at West Wemyss.

MR. R. W. HONEYWELL has recently been appointed representative for the Leicester area by Crofts (Engineers) Ltd., manufacturers of power transmission equipment.

MR. A. A. HAINING has been appointed Sales Manager of Exactor Ltd., of Edgware. Mr. Haining was formerly deputy Sales Manager of Sigmund Pumps Ltd.

MR. J. S. BROUGH has joined Humphreys & Glasgow Ltd., of London, from Monsanto Chemicals, Ltd., where he was general manager of production. As Technical Director and General Manager, he will act as deputy to MR. G. G. FARTHING, Deputy Chairman and Managing Director of Humphreys & Glasgow. Mr. Brough is an associate of the Manchester College of Technology, a member of the Institution of Chemical Engineers, the Institution of Mechanical Engineers and the Institute of Fuel. He is also a Fellow of the Institute of Petroleum. He will shortly complete a three-year term as a member of Council of the Institution of Chemical Engineers and is Chairman of Group A, British Conference on Automation and Computation.

MR. E. GRANGER was recently appointed Divisional Coke Officer, Central Division, Scottish Gas Board, in Perth. He went to Perth from Peterborough, Northants, and was on the staff of the coke marketing department, Cambridge Division, Eastern Gas Board, for seven years.

SIR JOHN STEPHENSON, soon to retire as Chairman of the Eastern Gas Board, was presented with an inscribed silver ashtray by SIR HAROLD SMITH, Chairman of the Gas Council, on behalf of the Voluntary Brigades of Tottenham Division, E.G.B.

MR. T. MERVYN JONES, Chairman of the Wales Gas Board, was recently installed as President of the Industrial Association of Wales and Monmouthshire.

MR. R. H. STUDHOLME, O.B.E., has resigned from the chairmanship of Metropolitan Gas Meters Ltd. The position is to be filled by MR. V. A. B. HUGHES. MR. H. ADCOCK, Managing Director and Chairman of the three subsidiaries, Cheltenham Meters Ltd., Metropolitan Meters (North Wales) Ltd. and Adcock & Shipley (Gas Meters) Ltd. has been appointed vice-Chairman.

Diary

April 8.—MANCHESTER JUNIORS: Visit to Parkinson Cowan Gas Meters, Ltd., Stretford. Paper by Mr. J. R. Teale, Senior Industrial Engineer, Stretford, on 'Clearing the Air.'

April 9.—NORTHERN JUNIORS: Newcastle-upon-Tyne. Paper by Mr. R. F. Hayman, Industrial Gas Officer to the Gas Council, entitled 'Gas in Industry.' 2.30 p.m.

April 9.—NORTH THAMES G.C.C.: Westminster City Hall, London, W.C.2. Council meeting at 2.30 p.m.

April 10.—I.G.E. MANCHESTER AND DISTRICT SECTION: Queens Hotel, Manchester. Annual general meeting. 2 p.m. Preceded by luncheon at 1 p.m.

April 10.—MIDLAND JUNIORS: President's Day. Inspection of the oil gas plant and compressor installation at Bilston, or inspection of the Dudley works compressor station. Luncheon at 1 p.m. Visits to a carpet factory, Wightwick Manor or a National Coal Board mine.

April 10.—JUNIOR INSTITUTION OF ENGINEERS: Pepys House, 14, Rochester Row, London, S.W.1. Paper on Radiography and its Application to Arc Welded Joints' by R. F. Wilks. 7 p.m.

Silver medal awards to junior associations

THE 1959 silver medal awards to junior gas associations, sponsored by the Society of British Gas Industries, are as follows:

London and Southern Junior Gas Association—to J. A. Bradley and G. E. Johnson for their paper: 'The ignition of town gas.'

Manchester District Junior Association of Gas Engineers—to H. Dobson for his paper 'Producers and Power.'

Midland Junior Gas Association—to T. Bryan for his paper 'Electrical economy in gas works.'

Eastern Junior Gas Association—to W. M. Johnston for his paper 'Towards preventive maintenance.'

Scottish Western Junior Gas Association—to A. M. Jackson for his paper 'Management and plant.'

The East of Scotland Junior Gas Association—to John H. A. Ramage for his paper 'Methods used in the preparation of water for boiler feed purposes.'

Wales and Monmouthshire Junior Gas Association—to K. M. Ernest for his paper 'Industrial gas sales development.'

The Yorkshire Junior Gas Association—to R. Fleming and P. G. Harris for their paper 'Desulphurisation of town gas by oil washing.'

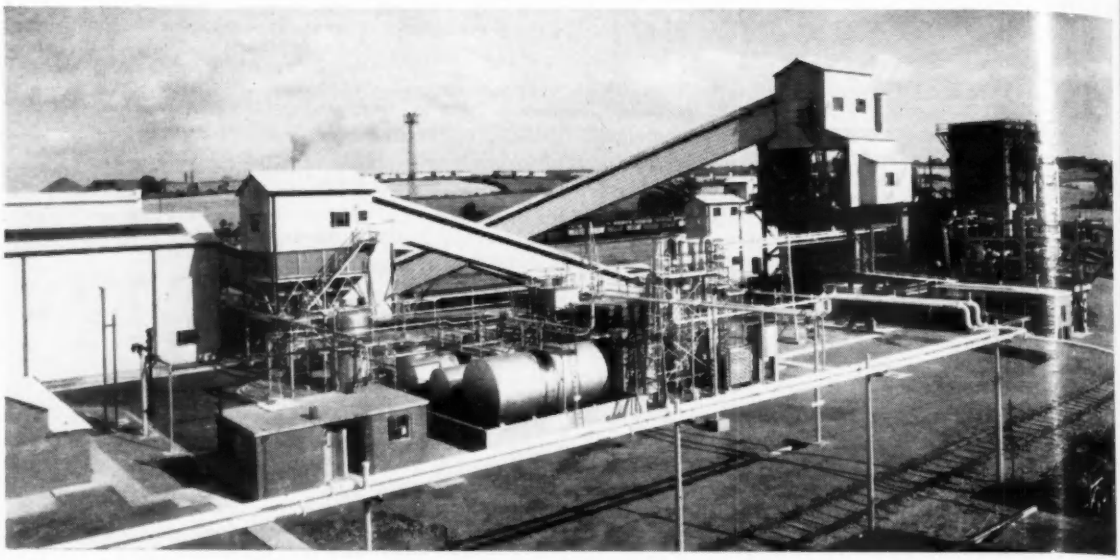
Guest of honour for Gas Council's sixth sales and service conference

THE sixth sales and service conference organised by the Gas Council will be held at Harrogate on Tuesday and Wednesday, October 6 and 7, 1959. The fifth conference was also held at Harrogate and proved so successful that it was decided to return to that town for the 1959 proceedings.

The guest of honour at the opening session of the conference on the morning of October 6, will be Sir Peter Roberts, M.P. for the Heeley division of Sheffield, who is also Chairman of Newton Chambers & Co. Ltd. Conference sessions will be held morning and afternoon, on both Tuesday and Wednesday, and there will be a civic reception in the Royal Hall on the Wednesday evening. Two special sessions will be held for those interested in industrial and commercial sales, and the concluding conference session, on Wednesday afternoon, will concentrate on marketing and publicity.

An exhibition of the latest gas and coke appliances will be held on a site adjacent to the conference hall. Conference headquarters will be at the Majestic Hotel, Harrogate, and complete details of the programme will be published in due course.

As on previous occasions, a special train will run from London to Harrogate on the Monday evening, with a return train on the Thursday morning. Any enquiries should be addressed to the Conference Organiser, Mr. R. J. Gregg, the Gas Council, 1, Grosvenor Place, London, S.W.1.



A picture of the test plant from the west. In the foreground is the by-product plant and behind this, left to right, the special coal preparation plant, the coke screening station, headhouse above the oven, and the quenching tower.

The new plant of the

B. C. R. A.

PROVIDES TEST FACILITIES ON A NORMAL-PRACTICE SCALE

BEFORE the formation of the British Coke Research Association in 1943 and its incorporation in 1944, research on hard coke had been carried out separately by the Midland, Northern and Scottish Research Committees, working from their own laboratories. In this way coke research in this country had been maintained for some 30 years, but it was decided in 1943 to bring these various activities under a centralised control.

A representative council was, therefore, elected to govern the collective research activities of the industry. Finance was provided by the British Coking Industry Research Association, assisted by grants from the Department of Scientific and Industrial Research.

The Midland Coke Research Station was inaugurated in 1950 to specialise in chemical and physical studies, the Scottish Committee was disbanded in 1949, and the Northern Committee became an advisory committee to the University of Durham as well as to the Association. It now guides the fundamental research work undertaken on the Association's behalf at the laboratories of King's College, Newcastle.

In 1945 a small research station was built at Pontypridd in South Wales to investigate swelling pressures exerted by coals during carbonisation, using a specially designed movable wall test oven.

In 1955, however, the Council of the Association decided to concentrate all research activities on a site near the Avenue coking plant of the National Coal Board at Wingerworth, near Chesterfield. Work began on this site in December of that year, and the new research centre was opened by H.R.H. the Duke of Edinburgh, on November 21, 1958.

Full size oven

The new test plant provides facilities for the carbonisation of coal on a scale directly comparable with normal coke oven practice, and consist of one full size silica coke oven, complete with regenerative heating system and by-product plant. Comprehensive blending equipment is installed and provision is made for the special pre-treatment of the coal. The general workshop laboratory contains test ovens of smaller sizes and also provides accommodation for special projects which might be undertaken in the future. An engineering workshop is also housed in this building.

Coal handling and treatment plant. Coal is received at the test plant in railway wagons for discharge into a hopper situated underneath the track. A steel grid covering the mouth of the hopper retains any lumps of coal which are above 3 in. in size. From the hopper the coal is conveyed beneath a magnetic separator to the pre-crusher (British Jeffrey-Diamond rigid hammer), which reduces the coal to below $\frac{3}{4}$ in. in size, and delivers it to a bucket elevator. The crusher may be by-passed if so desired. The bucket elevator delivers the coal to a shuttle belt conveyor situated above the blending bunkers, by which the coal is directed at will to any one of the six compartments.

The bunkers, which have a total capacity of approximately 90 tons, are constructed of mild steel with a coating of polyester resin on the inside

surfaces to facilitate sliding of the coal. Coal is released from the blending bunkers at a pre-determined rate by Simon constant weight feeders and transferred to the main conveyor belt, which carries it forward to the final crusher.

This crusher is a British Jeffrey-Diamond junior pulveriser capable of reducing coal with 10% moisture from a feed size of ¾ in. and below to a product of 90% below ⅛-in. mesh. The crushed coal passes through a trommel type mixer on to a conveyor belt running to the bifurcated chute situated on the headhouse on top of the oven from which the two charging cars are loaded. Provision is made for the crusher and mixer to be by-passed independently if desired. Two Pooley weighbridges are provided on the oven top for weighing the coal charge and two hoppers located beneath the headhouse are available for disposal of any surplus coal. These hoppers are also used when the residual coal in the handling system has to be cleaned out in changing from one blend to another.

If it is desired to carry out further treatment of the coal charge in addition to the routine crushing and mixing, the coal may be withdrawn from the system, conveyed to the special coal treatment house, and returned to the system at a point before the main conveyor leading to the oven top. In the special coal treatment house there are facilities for drying, screening, and adding liquid or solid materials to the coal. A gas-heated boiler which supplies steam to the test plant is also situated in the special coal treatment house.

The coal handling and treatment plant is designed to operate at a rate of five tons per hour, and the addition of the facilities of the special coal treatment house to those of the normal charge preparation scheme together with the arrangements for by-passing units which are not required, provides a flexible and comprehensive system for the pre-treatment of coal charges for the test oven.

Test-coking installation. The test oven is of the Woodall-Duckham Becker regenerative underjet design. Its dimensions—measured cold—are shown in Table 1.

TABLE 1

Length over brickwork ..	26 ft. 5 in.
Length between doors ..	23 ft. 10½ in.
Height of oven chamber ..	13 ft. 6 in.
Height from top of oven pad to top of battery ..	27 ft. 2¼ in.
Width :	
Coke side	15⅝ in.
Pusher side	15⅜ in.

The oven has a capacity of 398 cu.ft. which is equivalent to a charge of 8.88 tons of coal with a bulk density of 50 lb. per cu.ft. The walls are of hammerhead silica brick construction, each wall containing 16 vertical flues. The upper ends of the vertical flues in each wall enter a horizontal flue and the two horizontal flues are connected by six crossover flues passing from wall to wall over the top of the oven chamber.

The Becker type of oven is so designed that at a given time combustion is taking place in all the flues of one wall, whilst waste gas is passing through the flues of the other wall. The direction of flow is reversed at half-hourly intervals. High grade silica shapes and blocks were used in the construction of the oven chamber, combustion flues, and all other brickwork which is exposed to high temperatures, whilst firebrick was employed in other regions of lower temperature.

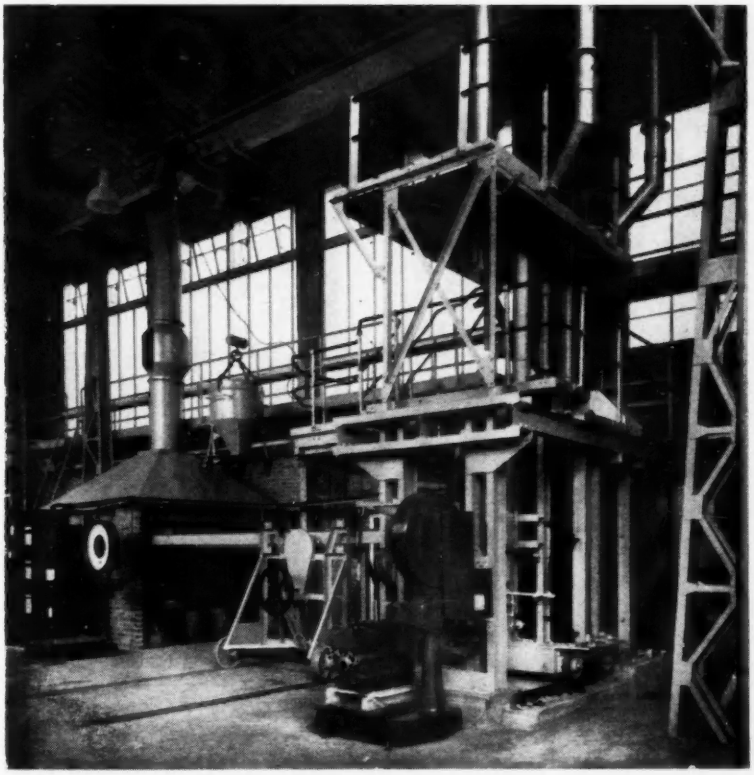
Timing device

There are two regenerators, one for each heating wall, each provided with a reversing valve which in turn connects it to the waste gas flue, or admits air for combustion from the atmosphere. An electrical timing device actuates the air and waste gas valves, together with the fuel gas cocks in order to reverse the direction of flow of the heating gases.

The oven is heated by purified coke oven gas which is conveyed to the test plant by a direct main from the near-by Avenue carbonisation plant of the National Coal Board. At a point close to the oven the gas main passes through a steam heater which ensures that the temperature of the gas is above the dew point; the main then divides and a fuel gas header pipe passes along each wall of the oven.

Individual riser pipes and fuel gas ducts passing through the regenerator brickwork feed the burners. The waste gases, after passing through the flues of the opposite heating wall and the regenerator, flow by way of the waste gas valve to the flue and the oven chimney. The chimney is about 60 ft. high, constructed of steel lined with firebrick, and provided with a centrifugal fan to assist in maintaining the necessary draught.

The two charging cars each consist of a single conical hopper mounted on a wheeled carriage and equipped with a quadrant type hand-operated discharge mouthpiece. A measuring cylinder fitted above the hopper may be raised or lowered to adjust the useful capacity of the car, the maximum



The interior of the general workshop laboratory, showing the movable wall test oven and ancillary equipment.

capacity being 200 cu.ft. The cars are manually propelled through a handwheel, gear and chain mechanism and fitted with electrically operated vibrators to facilitate discharging of the coal.

Tests may be carried out with either clay-luted or Koppers Equi-Press self-sealing doors. One set of each type is provided, together with matching removable door-frames. Door racks situated at the side of the oven are used to hold the set which is not in use.

The pusher side door extractor machine and the coke side combined door machine and coke guide are adapted to handle both types of doors, and otherwise conform to normal practice. The pusher side machine is manually propelled but that on the coke side is electrically driven.

The combined pusher and leveller machine resembles those used in commercial practice, except that no sideways traverse is required and so the machine is fixed in position. The equipment includes a retractable spillage chute and hopper by means of which coal withdrawn from the oven by the leveller beam is collected for weighing and disposal.

The coke quenching car is similar in design to those employed in commercial practice, being electrically driven and controlled from an operator's cabin located at one end. The two doors by which the coke is discharged on to the wharf after quenching are operated manually through a handwheel and worm reduction gear.

The quenching station is of the recirculation type and has a brick and concrete windshield 25 ft. high surmounted by a timber tower rising to a height of 56 ft. above the rail level. Baffles are fitted in the top of the tower to reduce the evolution of the larger droplets of condensed steam containing coke dust. The quenching tank has a capacity of 3,000 gal. and the operation is controlled by an automatic timing device.

Water which has not evaporated drains to a settling sump from which it is pumped back to the tank for re-use, while the breeze which has settled out is periodically removed. A Pooley weighbridge is incorporated in the coke car track between the oven and the quenching station so that the car and its contents may be weighed before and after the quenching operation.

Pressure regulated

Foul gas flows from the test oven through a single ascension pipe on the pusher side of the chamber into the gas collecting main. The ascension pipe is provided with a semi-cylindrical heat shield lined with asbestos, and is equipped with a steam connection for use during charging and decarbonising together with a liquor flushing spray. The 18-in. diameter main runs along the oven top, is reduced to a diameter of 6 in. and continues to a 6-in. diameter downcomer from which the gas passes to the by-product plant, and the flushing liquor is piped to the flushing tank. The gas pressure in the main is automatically regulated.

In order to accommodate the volume of dirty gas evolved during charging and levelling the oven is provided with a special bleeder by which the gases may escape to the atmosphere. The bleeder is located on the coke side of the chamber and fitted with a sleeve mounted on a counterbalanced lever which may be lowered to connect with the oven or raised to break the connection.

The hole in the roof of the oven has the same diameter as a charging hole and is covered by a similar lid when the bleeder is not in use. The gases escaping from the bleeder are ignited to reduce atmospheric pollution. When the charging and levelling operations are completed and the oven is ready to 'go on the main' so that the gas produced is passing to the by-product plant, the bleeder is disconnected and the lid replaced.

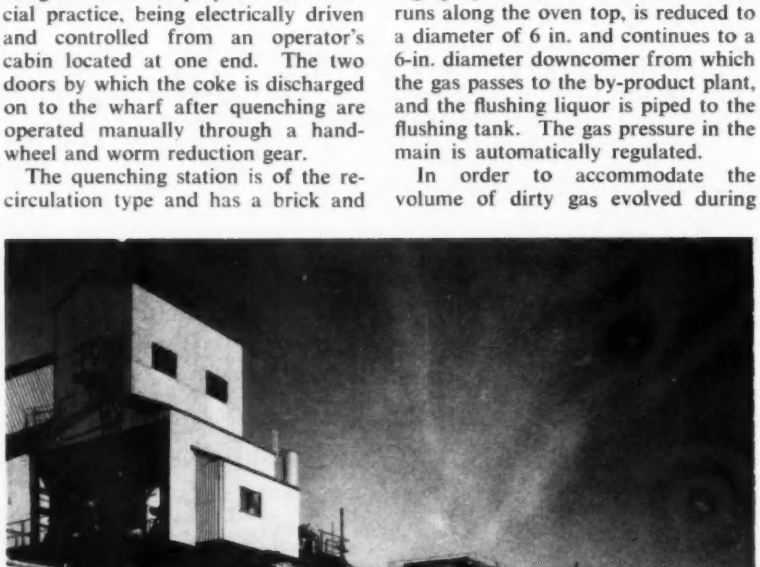
A number of instruments are installed in this section of the test plant and most of the recording and indicating mechanisms are grouped together in a panel situated in the instrument house adjoining the oven. In some cases the indicating mechanism is located at the measuring point for greater convenience.

The pressure of the incoming fuel gas is recorded and the rate of flow shown by an instrument which is a combined indicator, recorder and integrator. The rate at which the fuel gas is fed to each wall is regulated by two motorised valves which are positioned by controllers in response to the measurement made by a thermocouple situated in each wall, and in addition the pressure in the two feeder mains is indicated. Two temperature indicators show respectively the temperature of the fuel gas before and after it passes through the heater.

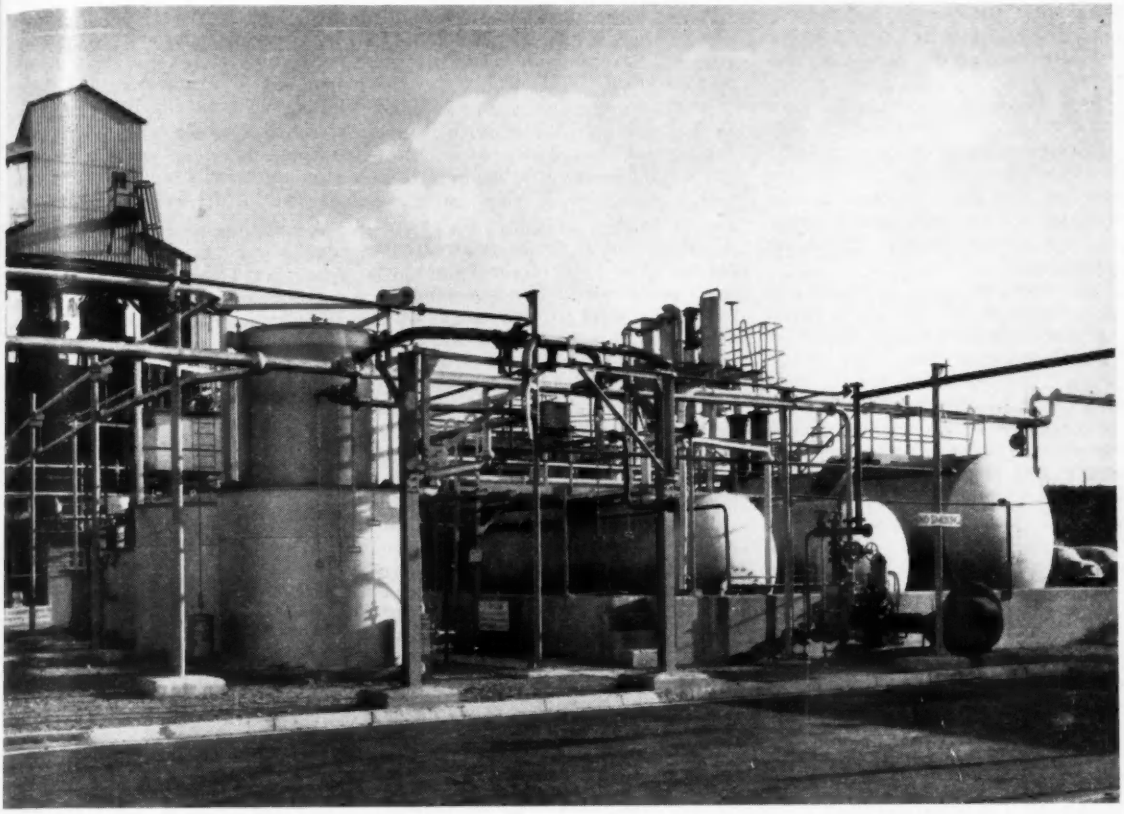
In addition to the two thermocouples in the oven flues which serve the gas flow controller there are two other thermocouples in each wall, so that the temperature at six points in the oven flues is recorded. A 12-point temperature recorder is available for use in conjunction with thermocouples inserted through the oven doors into the charge itself.

The temperature and pressure of the waste gases are indicated on the instrument panel, and additional thermo-couples in the waste gas flue are connected to a temperature recorder.

The temperature of the foul gas leaving the oven is measured by an indicating thermometer and the pressure in the main is recorded. The temperature measured by additional thermocouples at five points is also recorded and the pressures in the steam line and liquor line serving the ascension pipe are indicated by gauges. The current supplied to the pushing machine during discharging of the oven is automatically recorded as a



The pusher side of the oven. The headhouse and hoppers for disposal of surplus coal may be seen on the left, the pusher-side door and ram in the centre, the instrument house in the foreground and the quenching tower in the background.



The by-product plant, showing from left to right, holders, storage tanks for tar and benzole, fresh and spent oil, and crude liquor.

measure of the force required to remove each charge.

Coke handling and screening plant. The quenched coke is discharged on to a wharf which is of normal design but only large enough to accommodate one oven charge. At the foot of the wharf hose-pipe connections are provided for use in quenching hot spots in the coke, and regulating gates are fitted which may be individually raised to allow the coke to slide on to a conveyor belt. From this horizontal belt the coke is transferred to an inclined belt which transports it to the screening station. A vibrating screen separates the coke into two fractions which pass to separate hoppers for disposal.

Indirect by-product plant. The plant is designed to cool the gas and recover the primary by-products, tar, ammonia liquor and benzole, the maximum rate of operation being 15,000 cu.ft. per hour of gas. The volume of each by-product is measured, samples obtained for analysis, and the remaining material passed to the Avenue plant. The principal units are described in the order in which they occur in the gas flow line.

The primary cooler is of the vertical water tube type with a shell 2 ft. 6 in. long by 2 ft. 3 in. wide by 14 ft. 7 in. high, containing 280 tubes of 1-in. outside diameter. There are four passes for both gas and water, and two liquor sprays are fitted in the last gas pass to flush away any naphthalene deposited on the surfaces.

The Holmes Connersville exhauster is driven by a four speed electric motor and is capable of the average duty shown in Table 2.

TABLE 2

Volume of gas ..	10,000 cu. ft. per hour
Inlet suction ..	12 in. w.g.
Outlet pressure ..	1.75 lb. per sq. in.
Speed	400 rev. per minute
Power absorbed ..	3.8 h.p.

The maximum duty gives a gas volume of 20,000 cu.ft. per hour and the minimum 5,000 cu.ft. per hour. A by-pass containing an exhauster governor is provided for the controlling and starting up purposes. The exhauster house also contains the instrument panel for the by-product plant described in greater detail below.

An electro-detarrer — Whessoe-Woodall-Duckham 'Harwich'—of the suspended wire electrode type, follows the exhauster. The high tension equipment, consisting of a transformer, selenium rectifiers, condenser, and surge resistors housed in a oil-filled chamber, is capable of an output of 8 mA at 20 kV. An electrical control panel is situated on the side of the unit.

The ammonia washer is a bubble cap tower of 3 ft. 6 in. diameter and 10 ft. in height containing six trays each with 14 bubble hoods. Gas and water flow counter-current through the unit, which is capable of reducing the ammonia content of 15,000 cu.ft. of gas per hour from 315 to less than 2 grains per 100 cu.ft., when the inlet gas contains 2.5% CO_2 and has a temperature of 75°F. A second bubble cap tower of the same dimensions is used as the benzole washer. From this the gas goes forward to the meters while the wash oil passes to the regeneration plant by which benzole is removed.

The gas leaving the benzole washer in a 6-in. diameter main, is divided into two streams. The main stream passes through the B.M. station meter and a non-return valve and governor to the Avenue plant. A P.V.T.T. instrument connected to the spindle of the station meter gives a continu-

ous trace of the pressure and the temperature conditions of the gas so that the meter reading can be suitably corrected.

From a sampling point in this main gas is taken to the Fairweather continuously recording calorimeter. The second stream of gas is a sample which is withdrawn through a 1-in. diameter line equipped with a governor and a small meter into a gas sample holder.

The sampling meter is coupled of the spindle of the station meter so that the sample always consists of a fixed proportion of the total volume of gas. There are two holders each with a capacity of 200 cu.ft. and a gas blower is provided to circulate the gas between the holders, thus ensuring good mixing of the sample.

Tar and ammonia liquor are obtained in varying mixtures and concentrations from the downcomer carrying gas from the oven, in the condensate from the primary cooler, and from the electro-detarrer and ammonia washer. The tar and liquor are collected and separated in a sump, transferred to measuring tanks, and finally pumped to storage tanks to await collection by road vehicles. Ammonia liquor is circulated to the foul gas main and the final pass of the primary cooler in the normal manner.

Distillation process

Benzole is recovered from the oil leaving the washer in the wash oil regeneration plant, by a distillation process. The benzolised oil passes through a preheater into a still, from the base of which de-benzolised oil is recovered and returned to the washer by way of a rack-cooler, while the vapourised components pass forward into a benzole condenser followed by a separator, from which the product is pumped to measuring and storage tanks. Steam is supplied to both the preheater and still, and storage tanks provide for fresh and spent wash oil.

A metered supply of purified coke oven gas from the Avenue plant is available for bleeding into the gas main between the oven and the by-product plant. When the oven is empty in the interval between discharging and charging, the by-product plant is isolated by a valve in the main, and gas from the bleed is used to build up a slight pressure in the plant. The exhauster is allowed to idle at its lowest speed, circulating gas through the exhauster by-pass.

Liquid effluents which are produced in the by-product plant are passed into separators, from which the water is passed to the drains, the tar and ammonia liquor fractions transferred to the appropriate sumps, and the liquor which needs further treatment run into drums and taken to the Avenue plant.

The instruments mounted on a panel in the exhauster house perform the following duties. The pressure in the gas main at points after the exhauster, before the sampling meter, after the station meter, and at both gas holders is indicated and the pressure across the principal units of the by-product plant is indicated. The gas temperature at the inlet to each unit is indicated, and so is the water temperature at the outlet of the primary cooler.

An indicator-controller mounted outside the exhauster house regulates the flow of water to the primary cooler in response to the measurements of temperature at the gas outlet. A gas meter indicates and integrates the total volume of gas received from the Avenue plant for all applications on the test plant. There are pressure gauges on the steam lines to the preheater and still of the wash oil regeneration plant, and an instrument which measures the temperature of the vapours leaving the still and regulates the flow of water to the fractionating condenser accordingly.

Indicating thermometers are provided in the tar and liquor measuring tanks, the oil outlet of the rack cooler and the benzole outlet of the final condenser. A small panel mounted on the structure of the wash oil regeneration plant has thermometers indicating the temperatures at the oil outlets of the still and the preheater, and the vapour inlet of the fractionating column. An indicating flow meter is located in the wash oil circulating line.

Test plant control laboratory. The routine sampling analysis and testing of coal, coke, and by-products for the test plant and small scale ovens is carried out in this laboratory, which is situated within the general workshop laboratory building. An additional building on the test plant site is used to store samples and also houses the apparatus for testing the physical properties of coke.

The general workshop laboratory provides accommodation for test equipment intermediate in size between the laboratory and test plant scales. There are test ovens of approximately 5-cwt. and 15-lb. capacity respectively which are used for smaller scale carbonisation tests, but do not include any equipment for the recovery of by-products.

The 5-cwt. oven was formerly operated at the Pontypridd test plant of the Association and is of the movable wall type, specially designed for measurement of the pressure developed in an oven charge during carbonisation. One wall is mounted on a wheeled carriage so that when pressure is exerted it moves outwards, actuating a lever system and thereby raising a weight which is resting in a platform weighing scale. The coking pressure is automatically recorded from the apparent loss in weight of the load on the scale.

A comprehensive system of thermocouples records the temperature at points in the flues, oven brickwork and the charge itself. From one thermocouple in each wall a controller operates a valve in the fuel gas line to regulate the temperature of the wall. The flow of fuel gas to the oven is recorded and integrated, and the pressure in the gas offtake recorded.

Two other recorders are provided which are used with the Association's instrument for the measurement of internal pressure within the charge. The oven is charged from a hopper which is loaded at ground level and lifted to the oven top by an overhead crane, while the coke is discharged by a manually propelled ram into a small car, and quenched by means of a hose-pipe.

The 15-lb. oven was developed by the Association for the testing of blends for carbonisation. The instrumentation comprises a 12-point temperature recorder, a two-point temperature recorder-controller, and two indicating flow meters in the fuel gas lines.

On the end wall of the laboratory there are four standard flues for the testing of the performance of cokes in domestic appliances, two being used for open fires, and two for boilers. The laboratory is equipped with a heated drying floor and a mixing area, both of which are partially enclosed and fitted with extraction hoods. Part of the laboratory building is reserved for future use in the investigations of special projects.

Engineering workshop

Smaller rooms adjacent to the main laboratory comprise office accommodation, toilet facilities, stores, the test plant control laboratory, and a sample preparation room. The north-western end of the building is occupied by an engineering workshop with the associated stores and office.

The large-scale test plant and ancillary equipment were erected by the Woodall-Duckham Construction Co. Ltd., the main contractors to the Association for this work. The Association's architects for the laboratories and offices were Westwood Sons and Partners of London and the builders were Thomas Beighton and Son Ltd. of Chesterfield.

Weir Committee against joint meter reading

'THE BOARDS SHOULD REMAIN FREE TO SPEND SUMS ON ADVERTISING'

THE conclusions reached in the report[1] of the Weir committee, set up a year ago to investigate the case for co-operation between gas and electricity boards, show that 'it would not benefit consumers if these (the activities of the boards) were to be combined.'

The committee say that boards should be free to organise their own meter reading and billing, that there is no case generally for boards sharing service centres and showrooms, and that boards should be free to spend reasonable sums on advertising in order to be able to develop balanced sales of gas and electricity.

Regarding joint meter reading, the report states that most of the national women's organisations which gave evidence expressed opinions in favour of joint reading. Consultative councils told the committee that of a total of over 18,000 complaints they had received over the past 10 years, only 30, or one-sixth of 1%, were about joint meter reading.

There was conflicting evidence about whether a single joint bill or two separate bills would be preferred. Many people would not like to have to meet both bills at the same time.

At present there is no arrangement between the boards to send their bills at tactful intervals, but they generally arrive separately and the period allowed for settlement makes it possible to separate the payments. A number of boards said they feared that a change to combined bills would increase demands for facilities to pay by instalments, which would require more working capital, raise the cost of administration, and increase the risk of bad debts. The committee did not believe that administratively, joint meter reading would ever be as satisfactory or efficient as separate meter reading.

Sharing service centres

It was suggested that it would save money if boards were to share service centres and showrooms. The boards argued that they could not provide a proper service if they were compelled to share existing premises with their competitors.

The boards said that the Government policy of encouraging competition between the industries made it necessary for them to maintain qualified and enthusiastic sales staffs who were convinced of the merits of what they had to sell. They felt that this could not be done if showrooms were shared by competing industries, whether they were manned by joint or separate sales staffs and consequently the interests of the consumer would suffer.

The staff of a combined showroom would find great difficulty in answering the obvious question of a consumer as to which fuel and which appliance was recommended. It was accepted that in most cases adequate joint showrooms could not be established in existing premises, but would require the purchase or building of new ones, at considerable capital costs or increases in rental charges.

There might be some scope for sharing premises in outlying places where there was not sufficient business to justify two separate establishments.

Some witnesses had represented to the committee that all advertising by the boards was unnecessary and a waste of money. The committee did not agree with this view. If there was to be competition between the boards they must be able to tell consumers what they had to offer. In the light of Government policy that the two industries are to compete with each other, there seemed to be no case for requiring the boards not to advertise.

Figures for advertising expenditure were small and in terms of percentage on total turnover, represented about one-third of 1%. The advertising expenditure of the boards was modest in comparison with that of certain other industries, and makers of both gas and electrical appliances themselves expended considerable sums in advertising which were additional to those spent by the boards.

Apart from competition between themselves, the boards had also to compete with other industries; directly with oil and coal, indirectly with all other claimants for a share of the consumers' spending power. The boards had argued that they must strive to maintain their share of the market and this the committee accepted.

There was also a need to ensure an expanding demand for the output of the two industries if costs were to be kept down.

Criticism of advertisements of a type which simply said 'Gas is Best' or 'Electricity is Best,' without referring to particular uses or processes was made. A particular advertisement might seem to be a waste of money, but it was not possible for anyone except the boards to decide whether this was likely to be the case. It was suggested to the committee that the Women's Gas Federation and the Electrical Association for Women were unreasonably and unfairly subsidised by the industries. From information given to the committee it seemed that they did very useful work.

Suggestions had been made to the committee that the Boards might do more to abate the nuisance caused by repeated and apparently unco-ordinated excavations in the same length of street. Undoubtedly there were some grounds for complaint, but other authorities, such as the Post Office and water and drainage authorities, might be concerned.

Some boards regularly arranged to tell the public by means of information in the Press and notices in the streets concerned why it is necessary to cause inconvenience by steel works. This was helpful, and the committee recommended that all boards should do the same.

Should be free

Detailed conclusions of the committee are thus:

(1) Boards should be free to organise their own meter reading and billing in the way which seems to them most efficient and economic and most convenient for their consumers.

(2) We do not recommend joint meter reading, but we accept the possibility of certain special circumstances existing in remote and scattered areas which might permit of local joint arrangements.

(3) Boards should consider offering the alternative of estimated readings of credit meters, with one or two balancing readings a year, to credit-worthy consumers who are frequently away from home, or who desire to be relieved of quarterly calls from meter readers.

(4) Boards should continue to experiment with various meter reading and billing arrangements. We consider there is scope for extending the use of work study in the task of meter reading and collection. Boards should consider whether the arrangements for exchanging information about meter reading and billing procedures throughout the two industries could be improved.

(5) There is no case generally for boards sharing service centres and showrooms, but they should consider whether there is scope for doing so in some thinly populated country districts.

(6) They should also consider whether a rather wider use of mobile showrooms in some rural areas would meet consumers' requirements more economically than the provision of permanent buildings.

(7) The boards should remain free to spend reasonable sums on advertising in order to be able to develop balanced sales of gas and electricity. What is reasonable in particular circumstances should be settled by the boards concerned.

(8) We wish to stress the importance of boards keeping consumers, the consultative councils, the Press and other responsible bodies well informed about developments and abreast of progress in all fields affecting consumers.

(9) Information should be exchanged as far in advance as possible about plans involving street works. Where this is not done already, the highway authorities should take the lead in convening meetings of the interested parties. The boards should also, wherever possible, tell the public the nature and estimated duration of their major street works.

[1] Co-operation Between Electricity and Gas Boards. H.M.S.O. (Cmnd. 695). 2s.

From a paper to the Yorkshire Junior Gas Association, Wakefield, February 14.

Holder Anti-freeze by Water Circulating in Immersed Coils

By J. N. WALKER,
INDUSTRIAL ENGINEER, BRADFORD GROUP,
NORTH WESTERN GAS BOARD.

THE conventional method of preventing ice formation on the water seals of spiral and column guided holders is the injection of live steam at one or more points on the periphery of the tank and cups. Concentration of production has, however, reduced many small works to holder stations, and steam is no longer available as an auxiliary to the manufacturing process. This problem has been largely met by the provision of small boilers either solid fuel or gas fired in place of the works' steam previously available. Solid fuel fired boilers on anti-freeze duty require manpower at peak production periods, when it can least be spared. Automatic gas fired boilers, normally reliable, develop control faults operating under intermittent conditions, standing by in damp boiler houses, often for weeks at a time.

It is only on a basis of cheap steam that the injection method can be economically justified since the large proportion of the energy of the jet is utilised in moving the surface water and this energy could be much more economically supplied mechanically. Movement of the water is of course only necessary because with heat input at one or two points the water has to be moved to the point of injection to receive its heat. It is thus apparent that provision of uniform heat transfer offers the certainty of considerable fuel savings.

Electrically operated systems employing continuous coils of low temperature elements immersed in the water seals are a simple and reliable alternative to steam. There is, however, a natural reluctance to use a competitive fuel and the electrical therm is 2½ times as costly as its gas equivalent, when used for this purpose.

In 1954 Bradford Group decided to proceed with an installation employing a pipe coil immersed in the tank of two small adjacent single lift holders, the water to be supplied by a gas fired central heating boiler, with the design based largely on normal accelerated central heating practice. An examination of recommended heat requirements in terms of steam, gave inputs varying between approximately 1,000 and 500 B.t.u. per linear foot of water seal and it was decided to provide approximately the latter value. Table 1 gives transmission details and temperature requirements of various diameters of metal tube based on the accepted water to water transmission figure of 70 B.t.u. per sq. ft. per hour per °F. difference.

TABLE 1

Nominal bore	Surface area per lin. ft. sq. ft.	Transmission per lin. ft. per hour per °F. diff. B.t.u.	Temp. diff. to transmit 550 B.t.u per lin. ft. per hour	Required circulating water temp. with tank temp. at 35°F.
			°F.	°F.
¾ in.	·275	19	29	64
1 in.	·346	24	23	58
1¼ in.	·434	30	18·5	53·4
Double 1 in.	·692	48	11·5	47

To partially compensate for the drop in temperature in the coil as heat was transmitted, it was decided to divide the coil into three equal sections with the first section 1 in. B.S.P., the second 1¼ in. B.S.P. and finally a double 1 in. B.S.P. The ¾ in. coil was rejected because of excessive resistance at the rates of flow required and the double 1 in. is preferable to the 1½ in. which would occupy too much space, particularly if coils were subsequently to be laid in the cups. The double 1 in. also has a better heat transfer ratio than the 1¼ in. and the single 1 in. than has the 1½ in. The duration of operation of the plant was to be automatic, being controlled by an external air thermostat set at 34 to 35°F.

Anyone familiar with gas fired central heating systems—this installation was nothing more—will realise that it was simple and trouble free, and a second station with two small single lift holders, approximately 70 ft. diameter, was similarly equipped in 1956. Both installations have given excellent service with a minimum of maintenance. Designed, however, around a heat requirement figure evolved for steam application. they are not substantially more economical in fuel than orthodox steam injection systems, and the necessity to anti-freeze a larger two lift holder led to a reassessment of the position.

Cancelled Out

In these two installations, circulation temperatures considerably in excess of those in the last column of the table given previously were used principally to avoid condensation which occurs in gas fired boilers at output temperatures below 100°F. The blending of return water with flow water at the pump intake would, however, depress the flow water temperature to the required level. The thermal conductivity of metallic tube is embarrassingly high and on the experience gained so far, material of lower conductivity would permit slightly higher circulating temperatures. In practice this has been cancelled out by reductions in heat transfer requirements.

As a result of a discussion with I.C.I. it was decided that alkathene offered a practical alternative to metallic walled tube. This material has a softening point of around 150°F., well above our temperature require-

ments. Its conductivity is given as about .0092 c.g.s. units against .92 c.g.s. units for copper. The advantage gained is of course nothing like as high as that indicated in the above figures since the conductivity of the dividing wall plays a minor part in fluid to fluid heat transfer. It was nevertheless a step in the right direction. A major advantage was, however, that the coils were extremely easy to fit when compared with wrought iron. A simple experiment into the relative overall conductivity of copper and alkathene was carried out by the immersion of coils of each material in water standing at a constant temperature and observing the temperature rise when passing cold water through them. Results are given in Table 2.

TABLE 2

Material	Bath temp. °F.	Temp. rise in coil °F.	Rate of flow gal. per hr.	Transmission B.t.u. per sq. ft. per hour per °F. difference
Copper	143	20	92	69·65
Alkathene ..	143	4·8	94	12·75

Rates of flow in the above table are low, but a very approximate relationship is established.

It was also decided to abandon low pressure hot water practice and use much higher circulating heads; thus both reducing the temperature differential around the coil and also enabling smaller pipe to be used. Twin $\frac{3}{4}$-in. bore coils were finally adapted, together with reverse flow in the double coil which absorbed the temperature differential. Operational control in terms of air temperature is very wasteful because water cools much more slowly than air and the installation is in operation long before the water is at freezing point. Moreover with air control boiler operation is continuous while the air temperature is below the control point, regardless of the severity of the weather. Since the heat input must also be adequate for most severe conditions, considerable fuel wastage occurs with light or moderate frost.

A recent installation is on a two-lift spiral guided holder of 130 ft. diameter. The boiler has a rated output of 3.12 therms per hour with a gas rate of 780 cu.ft. per hour. As before, the design is based on conventional, accelerated, central heating practice with boiler and accelerator and with heating coils located in tank and cup. In this case, however, the conventional make-up tank could not be used because there was no suitable elevated position in which to locate it, but is replaced by a small pressure vessel. The vessel has water in its lower section with nitrogen from a cylinder above it. The cylinder is fitted with a two stage reducing valve, the final stage being adjustable between 0 and 30 p.s.i The nitrogen is maintained over the water at a pressure of 10-15 p.s.i., adequate to cover the maximum height of the cup coil—some 20 ft.

Outlet Pressure

The boiler is a cast iron sectional Ideal series 3 and supplies water at 100-110°F. blended with return water to a pump with a capacity of 20 gal. per minute against a 75-ft. head. The outlet pressure is thus about 40 p.s.i. The final temperature of the mixed water is between 70 and 75°F. Boiler flow water is thermostatically controlled at 100-110°F. to avoid excessive temperatures in the alkathene coils, should mixing fail. The arrangement of holder connections are identical with those with steam except that the pipework, rigid and flexible, is duplicated, to provide both a flow and the return. The major pipework is in wrought iron with copper at the actual coil connections. The alkathene to copper connections are made under water —again an insurance against excessive flow water temperature. The double coils of $\frac{3}{4}$ in. bore alkathene are used at approximately 6-in. centres with the top coils 4 to 6 in. below water level. The coils are supported with simple brackets at 6- to 8-ft. centres. Automatic air vents are fitted as required.

The operation of the boiler and pump are separately controlled. Pump operation is determined by an air thermostat located outside the boiler house set at 34°F., which avoids a boiler house to holder connection freeze up if air frost should persist for some time before the instruments on the holder call for heat. Two electric mercury-in-steel indicating thermostats are wired in parallel and actuate a solenoid valve on the boiler gas supply. Dual thermostats have been found necessary because winds on a particular section of a holder can cause considerable ice formation locally while the rest of the periphery is free. The two thermostats are sited approximately north and east.

Water Level Unit

The maintenance of pressure in the system is safeguarded by an Elcontrol water level control unit, with its probe immersed in the water in the pressure vessel. A system leak will lower the water in the pressure vessel and will bare the tip of the probe, breaking a micro volt circuit. Relays then come into operation which stop the pump, shut down the boiler and actuate an alarm system.

Temperature curves were plotted during the test run over 24 hours. Night temperatures were unfortunately considerably higher than forecast and the picture is therefore not as complete as it might have been. If, however, day and night temperatures are reversed, the air temperature throughout the period is representative of a typical night with moderate frost, followed by a day in the middle thirties. Total boiler operation over this period amounts to approximately 1 hour 40 minutes with a gas consumption of 6.47 therms.

The temperature difference between the cup and surrounding air at the time was 2 to 2½°F. The maximum temperature reached by the water was 38 to 39°F., which represents a considerable overshoot over the 34°F. control point. Lower flow temperatures obtaining for longer periods will eradicate this fault. The design heat input rate of 200 B.t.u. per hour per linear foot of water seal could be very considerably reduced on the evidence of the test run, for a holder in unexposed locations. This should, however, be examined with caution for reasons given later.

The first installation to the modified design was completed for the beginning of the 1957/8 winter and apart from some preliminary difficulty in maintaining the correct balance between the boiler and the return water, it ran without trouble throughout the winter. Experiments were carried out with temperature control at varying levels and on occasions some ice was formed in the cup. No ice was ever apparent on the tank. This

tied up with our theoretical ideas—that because of its lower thermal capacity the cup would cool quicker and ice formation here would always precede ice formation on the tank surface. It was only necessary to control, therefore, in terms of cup water temperature.

In the 1957/8 winter, which in degree day terms was average, minimum temperatures of 20 to 22°F. were reached on several nights. There were, however, no periods of continuous cold extending over two to three weeks such as was experienced in January of this year. At the end of this period a slight film of ice was present on several occasions on the holder tank which was the subject of the test run, indicating that control in terms of cup water was barely adequate. On an installation completed for this winter with a single boiler and pump supplying two holders, the larger in continuous use with the smaller held as a standby, control is in terms of the larger holder cup. Considerable ice formation has occurred in the tank of the standby holder and at the end of the cold spell some ice was also present on the tank of the control holder. The ice is in a peculiar soft lamellar form and shows signs of temporary thawing with each boiler control cycle called for by the cup instrument above it. Both these holders have the top 6 ft. of their tanks exposed.

Not Permanent Answer

We expect to temporarily control the formation of tank ice by reducing the rate of water flow around the cup circuit which will have the effect of extending the control cycles; thus putting more heat into the tanks. We feel that this is not the permanent answer to the problem since the arrangement will lead to a waste in fuel under normal frost conditions.

The problem can be permanently tackled by the provision of duplicate coils in exposed tanks—the second coil to be operative only in prolonged periods of frost. Alternatively control thermostats can be provided in both tank and cup with or without independent coil control. More experience is needed both in the cooling rate of exposed tanks and also in the effect of general ground cooling caused by periods of continuous frost, before deciding which alternative is to be preferred. In the installation mentioned above where ice has been formed on tank water surface, the ice formed on the working holder was slight and only occurred at the end of two to three weeks of continuous cold weather. The ice formed on the standby holder was considerable and occurred early in the cold period. It would appear that incoming gas temperatures have some effect on the tank surface water cooling rate. Penetration of frost to considerable depths will depress the inlet gas temperature to approaching freezing point and no heat will be transmitted to the water from this source.

Negretti and Zambra indicating thermostats which have been used up till now have mercury-in-steel systems with capillary connections between the bulb and the instrument. The bulbs are at present fixed horizontally at a depth of about 1 in. We are investigating whether it would be practical to attach the bulb to the underface of floats to improve sensitivity and to compensate for changes in water level. A simple form of hydraulic accumulator is being considered as a possible alternative to nitrogen pressurisation when make up tanks cannot be used.

Inputs in the 500 to 1,000 B.t.u. per hour linear foot range, applied with steam, should guarantee ice free holders regardless of size, exposure, severity of weather, etc. If we are to reduce fuel consumed by supplying the minimum heat necessary to avoid ice formation under widely varying conditions I feel that the system described in this paper has advantages over its electrical equivalent since, if generous boiler capacity is provided, a wide range of overall transmission rates and considerable variation in transmission from individual coils is simply a matter of valve adjustment.

British Standard for Conversion Factors

ONE of the most thumbed reference books in use by science and industry—*B.S. 350, Conversion Factors and Tables*—is being revised, and a first part has now been published in a 114-pp., fully-indexed volume. The standard will be much enlarged in scope by its revision, and when this has been completed it will cover, broadly, units, their abbreviations, conversion factors and detailed conversion tables for a wide range of subjects falling under the general headings of metrology, mechanics and heat.

Part 1 gives extended basic information on units, together with the standard abbreviation for each unit or combination of units considered. A feature of the standard is the inclusion of comprehensive tables of conversion factors, showing the relationship between any two of the British and metric units used in the measurement of a given physical quantity. Summary tables of units and conversion factors are also included, together with an appendix on thicknesses of sheets and diameters of wires.

Sub-titled ' Part 1:Basis of tables; conversion factors,' the new publication will eventually be joined by a ' sister ' part—Part 2—which is now being prepared and will include a more extended range of tables than those in B.S. 350:1944. A list of the detailed conversion tables allotted to Part 2 will be found in Part 1. When Part 2 is ready, the two parts will be available either separately or as a combined standard. In the meantime, the detailed tables of the 1944 edition will still be serviceable, and are obtainable at the reduced price of 7s. 6d. a copy, but the other parts of that edition are now superseded by the new Part 1.

Difficulties due to the small differences between the British and U.S. legal yards, and likewise between the legal pounds, have been overcome by the use in B.S. 350 of common units of length and mass defined by means of the following relationships:

1 yard = 0.9144 metre

1 pound = 0.453 592 37 kilogramme

These are the definitions adopted in 1959 by the National Standards Laboratories of Australia, Canada, New Zealand, South Africa, the United Kingdom, and the United States of America for use in science and technology.

Copies of this Standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price, 15s. (Postage will be charged extra to non-subscribers.)

Short paper to the Yorkshire Junior Gas Association, Wakefield, February 14, 1959.

Some Experiences at a Large New Works

By E. HASLAM, A.M.Inst.Gas E.

ASSISTANT WORKS MANAGER, TINGLEY WORKS, LEEDS GROUP, NORTH EASTERN GAS BOARD.

THE gasworks at Tingley was originally projected by the former United Kingdom Gas Corporation to boost the gas supply to the West Yorkshire gas grid. The plant was to be built in two halves. At vesting day the construction of the first half was well advanced and the whole project became vested in the North Eastern Gas Board.

The works produces 14 mill. cu.ft. of gas per day from 144 intermittent vertical chambers built by the Woodall-Duckham Construction Co. Ltd. The gas is purified in eight tower purifiers of W. C. Holmes & Co. Ltd. manufacture, the towers being equipped with the usual stocking tower, stocking frame, Goliath crane, and purging machine. All the gas is compressed into the grid at up to 30 lb. per sq. in. There are two steam driven vertical reciprocating compressors, two vertical reciprocating compressors driven by fixed speed electric motors, and one vertical reciprocating compressor driven by a variable speed electric motor.

The works is operated under base load conditions and produces approximately 79 therms of gas (excluding benzole), per ton of coal carbonised, at a c.v. of 500 B.t.u. per cu.ft. The normal carbonising period is 12 hours 40 minutes, some 6-7% of steam being admitted during the last two hours or so. It should be noted that 4-5% of air is admitted at the tower purifiers and approximately 1.5 gal. of benzole per ton of coal carbonised is extracted.

Producer gas dilution plant is installed but not normally used. Theoretically, it would be possible to obtain higher gas makes if benzole extraction was ceased, and steaming reduced in conjunction with a shorter carbonising period, using producer gas to dilute the richer gas to a c.v. of 500 B.t.u. per cu.ft. However, it is doubtful whether the tower purifiers could cope with the extra load, and other difficulties could very well present themselves.

Short Life for Cars

When a chamber is ready to be discharged, a hydraulically-operated door at the bottom of the chamber is opened and the hot coke falls into a car which runs on rails laid in the floor underneath the setting. The car is hauled by means of an electrically-driven chain haulage gear, to a quenching tower, where the hot coke is quenched with water from overhead sprays. The car is then hauled outside the chamber house onto a bridge over a hopper, into which the coke is dropped by opening doors which are fixed onto the coke car. The short life of these cars gave rise to great concern. The first car had a life of only 3½ months and the second four months. This was during 1953 when only one car was working. With the plant in full production, four cars would be in use, and with a life of only four months would mean renewing a coke car every month at a cost of some £1,200. Other works with similar installations were visited, the quenching water analysed, and the operation of the plant carefully checked. The quenching water was augmented by effluent from the liquor effluent treatment plant. Difficulties were met in the operation of this plant and a completely pure final effluent was difficult to achieve. These difficulties have been fully described by Egan.[1]

It was concluded that the quench in use at Tingley was corrosive, as similar installations were obtaining a much longer life, although analyses of the quenching water being used had shown only small amounts of corrosive constituents. It was decided to have a car built by the works maintenance staff. This was done at a great saving in cost. Improvements in design were made and a life of some 6½ months was achieved.

Acute Water Shortage

The National Coal Board pump water from old colliery workings beneath the Tingley site, and some of this water had been used for coke quenching to augment the poor town water supply. The water shortage often became acute after the third quarter of the plant went to work in February, 1955. For example, it took four months to fill a new holder tank with approximately 2 mill. gal. of water. In preparation for the last quarter of the plant to commence gas making in November, 1955, a scheme was developed to make full use of this pit water for coke quenching. One of the two tar storage tanks was cleaned out and used for pit water storage. A pump was installed to deliver the pit water into the tank, from which it was piped into the quenching water sumps. This coincided with the shutting down of the liquor effluent treatment plant, and it was hoped to obtain a still longer life from the coke cars. During 1956 the average life was only some seven months and the pit water became suspect. The building of these cars was costly and constituted a severe drain on the mechanic's shop manpower. Analyses of the pit water showed it to have no undue corrosive properties, and a firm of consultants substantiated this.

Further improvements in the design of the car were made. The steel body of the car which had been $\frac{3}{16}$ in. thick and increased to $\frac{1}{4}$ in., was now increased to $\frac{3}{8}$ in. The method of riveting the steel grillage lining to the body was changed to a more robust fixing. The doors were redesigned to counteract warping and many minor improvements were made.

A car with cast iron lining plates in place of the steel

grillage was obtained. This was in use for six months, and after being taken out of service for considerable repairs lasted another ten months. The improved steel cars now last approximately 12 months. Only minor repairs are necessary during this period, and it is hoped to obtain even a longer life. Therefore, they compare very favourably with the cast iron lined car, particularly in view of its high initial cost.

With only the first quarter of the plant gas making, five of the eight tower purifiers were being used and satisfactory purification was achieved with minor difficulties. Conditions began to deteriorate when the second quarter of the plant was put to work. Apart from a general tendency for the efficiencies of the towers to be low, several of the double-faced disc valves began to leak and it became difficult to purify the gas to statutory requirements. Attempts were made to seal the leaking valves by flooding their bonnets with water and some success was achieved, although conditions were extremely difficult at times owing to the very low town water pressure. One valve leaked so badly, that when water sealing was attempted, the level of liquor in the well rose noticeably after several hours.

The makers advised lubrication of the internal parts of the valves, and a machine was obtained to do this. It consisted of a tank containing creosote oil, with a pump and motor mounted upon a bogie. Hose connections were made to the bonnet of the valve while in the closed position, and the bonnet filled with oil, which was then allowed to drain back to the tank. No noticeable improvement was obtained and losses of oil were sometimes high. It is now intended to modify this machine, so that the valve bonnet can be filled with oil more rapidly and thus reduce oil losses.

The hydrogen sulphide in the crude gas averaged 700-750 gr. per 100 cu.ft., and was often much higher. Other tower purifier installations were known to give difficulty when the hydrogen sulphide in the crude gas was high, and coals low in sulphur were specially selected for use at Tingley. The concentration dropped to 500-550 gr. per 100 cu.ft., and conditions became greatly improved, but still unsatisfactory.

Position Serious

When the third quarter of the plant began gas making in 1955, the three remaining towers were brought into use and conditions remained much the same. The position at this time was; that considerable difficulty was being experienced in purifying 10.5 mill. cu.ft. per day, and later in the year the make was to be increased to 14 mill. cu.ft. per day; 5% of air and occasionally more was being added for revivification. The position was, to say the least, rather serious.

Some misfortunes had occurred with the 60-ton Goliath crane, which is used to lift the trays of oxide in and out of the towers. The towers are in a very exposed position, and during abnormally high winds the crane had been blown off its tracks. During 1955 a modified set of rail clamps were fitted, which enabled the crane to be securely anchored in position should any high winds occur. A wind speed indicator was fitted and instructions given that the crane must not be used in winds exceeding 35 m.p.h. In 1956 an additional set of bogies were fitted, complete with driving motors and thruster brakes, which enabled the crane to be used despite high winds. This was a great improvement as purification work could now continue despite the weather and the possibility of having the crane out of use for several weeks due to breakdowns was minimised.

The work of emptying the trays of used oxide was slow, dirty and laborious. If the purifying position was to be improved, it was imperative that this work should be speeded up. In June, 1955, the work was put on a piecework basis, and this problem virtually ceased to exist.

Sealing Rings Renewed

The preparation of the oxide charges and the filling of the trays was most carefully supervised to ensure thorough mixing of the oxide and correct filling of the trays. The rubber sealing rings between each tray were renewed each time a tower was changed, as short circuiting could occur at this point. The leaking valves were of great importance. The continuity valves on the set are in such a position that should a leak occur, gas from the inlet stream leaks directly onto the outlet. The valves are 42 in. diameter, and it should be noted that a leak of only approximately 100 cu.ft. per hour would foul the outlet gas beyond the statutory limit.

After several trials a scheme was adopted to overcome the effect of these leakages. Clean gas from the main outlet of the towers was piped to a Connersville type blower, in which the gas was compressed to approximately 3 lb. per sq. in. and then lead into a pipe running down between the towers. From this pipe 1 in. connections were made to the top of the bonnet of each individual 42 in. valve. Each 1 in. connection was fitted with a valve. A by-pass connection and valve were fitted to the blower so that the pressure could be adjusted.

System of Operation

There are eight inlet valves, eight outlet valves and eight continuity valves in all. In any normal rotation there are seven inlets shut, seven outlets shut and one continuity shut. The system of operation is, that after each rotation the individual 1-in. valves supplying gas under pressure to the valve bonnets are opened to any main valve which is in the shut position, the remaining 1-in. valves are shut. Should any valve fail to seat properly, clean gas under pressure leaks outwards over the valve seats, thus preventing any leakage through the valve. The pressure at the blower is adjusted by means of the by-pass after each rotation of the towers. This has now been very successful and a more permanent installation is now being built, complete with stand-by blower and motor.

Attention to all the points mentioned gave a large degree of success. Some fully spent oxide was produced, air for revivification was reduced and a small margin of safety created. Part spent oxide still accumulated on the works. It was hoped that some could be worked up to saleable standard after March, 1958, during repairs to the first quarter of the carbonising plant, when the load would be reduced to 75% of normal. Two towers were filled with all part spent oxide. The position rapidly deteriorated and became very serious during April, when a constant watch on the towers day and night was necessary and rotations were

often as frequent as three-hourly. The position returned to normal after the oxide in the offending towers had been changed.

Towers towards the end of the stream have on occasions thrown off H_2S. The precise reasons for this are not known. Sometimes the trouble has disappeared after a few weeks, but at other times the oxide has had to be changed in order to effect a cure. The amount of H_2S thrown off is small but sufficient to cause embarrassment. A washer filled with zinc acetate solution would cure this and the amount of chemical used would be small.

Wear and Tear on Valves

The method of operation described by Brown, Porter and Thompson[2] is being considered. They found that rotation as frequent as four hourly and possibly two hourly gave astoundingly better results. At Tingley the towers are normally rotated every 24 hours. We are very apprehensive regarding the amount of supervision needed and the wear and tear on the valves in frequent rotation. On two occasions the internal parts of continuity valves have broken and repairs carried out satisfactorily, but a complete works shut down may be necessary should either an inlet or an outlet valve be broken.

On one of the fixed speed compressor machines with electric motor drive repeated piston failures occurred as shown below:—

22.12.54	15.3.55	7.6.55	27.8.55
Left-hand piston	Right-hand piston	Left-hand piston	Right-hand piston

The type of failure was much the same in each case. A loud knocking was heard from the machine and on inspection it was found that the core plugs in one of the pistons had worked loose to such an extent as to cause them to strike the cylinder base, and there was a circular crack in the piston which passed through the core plug holes. Originally it was thought that the sequence of events was as follows:—

1. Loosening of the core plugs due to vibration and inadequate method of fixing.
2. Cracking of the piston due to the excessive load induced when the core plugs struck the cylinder base.

This was later shown to be wrong and that actually the pistons were being fatigued, the cracks appearing first at the weakest part, i.e., through the core plug holes, and this causing the core plugs to become loose. This theory being borne out by the regularity of the failures. Pistons of an improved design were fitted. The core plug holes were moved nearer to the rim and increased compensation allowed for them. Elliptical holes were used in the ribs and were also placed nearer to the rim. The top and bottom plates were increased in thickness and all fillets increased in size. The ribs were thickened and a special grade cast iron of 20 tons per sq. in. tensile strength was used. No similar failures have occurred since these new type pistons were fitted.

The failures of a cross head bolt in a steam driven machine, a counter-balance weight bolt in one of the fixed speed machines, and a cross head bolt in the other fixed speed machine, all resulted in major damage to the machine concerned. The damage in itself was serious but especially important as all three failures occurred in the space of one month, and for a short time insufficient compressing plant was available to deal with the full make. There would be no point in giving details of each bolt failure, but that concerning the balance weight bolt may be of some interest.

The overall length of the bolt was $9\frac{1}{2}$ in., the diameter of the threaded portion $1\frac{5}{16}$ in., and it was screwed 11 t.p.i. for a length of $1\frac{3}{4}$ in. To prevent the bolt unscrewing a collar was fitted immediately under the bolt head. This collar had a screw which engaged one of six blind holes drilled in the shank of the bolt. Rotation of the collar itself was prevented by means of an integral lug which engaged with a recess in the balance weight. The insurance company's research engineers suggested that the sequence of events was as follows:—

Due to inadequate tightening of the bolts, the balance weight was able to move very slightly in relation to the crankshaft, this giving rise to fluctuating bending stresses in the affected bolt. As a result of the increased stress, fatigue cracks developed in the threaded part of the bolt and ultimately extended across the whole section. An overload was thus thrown onto the remaining threads which engaged the crank web, causing small fatigue cracks to develop in them, the few remaining sound ones finally shearing and allowing the bolt to come out of the web.

These bolts should be sufficiently tightened, i.e., prestressed when fitted, and with the bolt in question the optimum total strain would require rotation approximately equivalent to the angle between the six locking screw holes. Thus, if during tightening the correct position happened to be between two locking screw holes, there would be a temptation to stop tightening when a hole came into line, rather than to apply what might be an excessive torque to bring the next hole into line. The practice of pre-determining the location of holes used with locking devices is an undesirable one; a bolt should be tightened properly, then any hole for the reception of a locking screw drilled afterwards.

Valve Plate Breakages

At one time there occurred a very serious epidemic of valve plate breakages. This seemed to be associated with excessive deposits of gum on the plate, though analyses of the gas showed only small concentrations of gum. Live steam was admitted at inlet holder in order to ensure saturation of the gas, it being hoped that this would cause the gum to be deposited harmlessly into the holder water. Tetrahydronaphthalene was fed into the gas at the inlet to the compressors, and although this kept the plates largely free from gum deposits, the breakages still occurred.

Different arrongements of the valve assemblies were tried without success. Some new types of valves, incorporating stainless steel plates, were fitted, but these also broke in time. Eventually the trouble cleared up. The live steam admission and the tetrahydronaphthalene drip were stopped and little trouble has occurred since.

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